The 2020 Around-the-Clock Around-the-Globe Magnetics Conference: Invited speakers information

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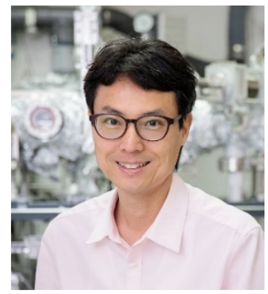

Title of the talk: **Magnetization switching based on topological spin textures and magnons**

Biography:
Hyunsoo Yang is a Globalfoundries Chaired Professor in the Department of Electrical and Computer Engineering, National University of Singapore (NUS), working on various magnetic materials and devices for spintronics applications. He worked at C&S technology, LG Electronics in San Jose, and Intelligent Fiber Optic Systems, California. He received his Doctorate from Stanford University. From 2004-2007, he was at IBM-Stanford Spintronic Science and Applications Center. He has authored 200 journal articles, given 180 invited presentations, and holds 15 patents. He was a recipient of the Outstanding Dissertation Award for 2006 from the American Physical Society (GMAG) and IEEE Magnetics Society Distinguished Lecturers for 2019.

Abstract:
Layered topological materials such as topological insulators (TIs) and Weyl semimetals are a new class of quantum matters with large spin-orbit coupling. We reveal spin textures of such materials using the bilinear magneto-electric resistance (BMR), which depends on the relative orientation of the current with respect to crystallographic axes [1,2]. We also visualize current-induced spin accumulation in topological insulators using photocurrent mapping [3]. Topological surface states (TSS) dominated spin orbit torques are identified in Bi_2Se_3 [4], and magnetization switching at room temperature using Bi_2Se_3 as a spin current source is demonstrated [5]. In order to tackle current shunting issues in TI, we propose two approaches. Weyl semimetals have a larger conductivity compared to TIs and they can generate a strong spin current from their bulk states. We show the current-driven magnetization switching in WTe_2/NiFe with a low power [6].
The current shunting issue can be also overcome by the magnon-mediated spin torque, in which the angular momentum is carried by precessing spins rather than moving electrons. Magnon-torque-driven magnetization switching is demonstrated in the Bi_2Se_3/NiO/Py devices at room temperature [7]. By injecting the electric current to an adjacent Bi_2Se_3 layer, spin currents were converted to magnon torques through an antiferromagnetic insulator NiO. The presence of magnon torque is evident for larger

values of the NiO-thickness where magnons are the only spin-angular-momentum carriers. The demonstration reveals that the magnon torque is sufficient to control the magnetization [5].
Looking towards the future, we hope that these studies will spark more works on harnessing spin currents from topological materials and revealing interesting spin textures at topological material/magnet interfaces. All magnon-driven magnetization switching without involving electrical parts could be achieved in the future. The results will invigorate magnon-based memory and logic devices, which is relevant to the energy-efficient control of spin devices.

References:

[1] P. He et al., “Bilinear magnetoelectric resistance as a probe of three-dimensional spin texture in topological surface states” Nat. Phys. **14**, 495 (2018)

[2] P. He et al., “Nonlinear magnetotransport shaped by Fermi surface topology and convexity” Nat. Comm. **10**, 1290 (2019)

[3] Y. Liu et al., “Direct visualization of current-induced spin accumulation in topological insulators” Nat. Comm. **9**, 2492 (2018)

[4] Y. Wang et al., “Topological Surface States Originated Spin-Orbit Torques in Bi_2Se_3” Phys. Rev. Lett. **114**, 257202 (2015)

[5] Y. Wang et al., “Room temperature magnetization switching in topological insulator-ferromagnet heterostructures by spin-orbit torques” Nat. Comm. **8**, 1364 (2017)

[6] S. Shi et al., “All-electric magnetization switching and Dzyaloshinskii–Moriya interaction in WTe2/ferromagnet heterostructures” Nat. Nano. **14**, 945 (2019)

[7] Y. Wang et al., “Magnetization switching by magnon-mediated spin torque through an antiferromagnetic insulator” Science **366**, 1125 (2019)